

Boeing 757-236, G-BPEE

AAIB Bulletin No: 8/99 Ref: EW/G98/07/35 Category: 1.1

Aircraft Type and Registration: Boeing 757-236, G-BPEE

No & Type of Engines: 2 Roll-Royce RB211-535E4 turbofan engines

Year of Manufacture: 1991

Date & Time (UTC): 28 July 1998 at 1025 hrs

Location: Belfast City Airport

Type of Flight: Public Transport

Persons on Board: Crew - 7 - Passengers - 168

Injuries: Crew - None - Passengers - None

Nature of Damage: Damage to No. 2 engine cowling, cable looms on engine, and the IDG

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 48 years

Commander's Flying Experience: 9,000 hours (of which 1,500 were on type)

Last 90 days - 180 hours

Last 28 days - 60 hours

Information Source: Aircraft Accident Report Form submitted by the commander and AAIB enquiries

IDG problem on previous flight

On the previous flight from Manchester to Heathrow, the crew had received 'GEN DRIVE' and 'GEN OFF' warnings for the No 2 engine on the Engine Indication and Crew Alerting System (EICAS). The crew therefore operated the Integrated Drive Generator (IDG) disconnect switch and then used the Auxiliary Power Unit to provide additional electrical power, as required by the Quick Reference Handbook and Standard Operating Procedures. After the arrival at Heathrow, the 'Status/Maint MSG' page had indicated 'BPCU BITE' (electrical Bus Power Control Unit fault detected by the Built in Test Equipment), 'DP TRIP' (Differential Protection loss) and 'IDG LOW OIL PX' messages. The IDG oil level had subsequently been inspected and found full. The No 2 engine had then been run up to idle and the disconnect switch operated again, this being an additional requirement following an IDG disconnect to ensure that manual reconnection of a defective IDG has not been carried out, in error, by maintenance personnel. The aircraft had then

been cleared for a flight to Belfast with the No 2 engine IDG inoperative and with an Aircraft Deferred Defect entry in the Technical Log for later IDG replacement, in accordance with the permitted deficiencies in the Dispatch Deviation Manual.

Incident flight

However, during the subsequent Heathrow to Belfast sector, when the aircraft was in the cruise at Flight Level 260 over the Isle of Man, a No 2 engine fire warning occurred with activation of the fire warning bell and illumination of the associated fire warning lamps. The crew carried out the engine fire drill and after some 30 seconds, during which the second fire extinguishant bottle was fired, the fire warning cancelled. An emergency was declared and the flight continued to Belfast where the aircraft landed without further incident.

Maintenance inspection findings

Subsequent engineering inspection of the right engine revealed that an uncontained failure of the IDG casing had occurred and caused considerable oil staining of the fan case in addition to fire damage to the fan cowl inner skin and engine wiring in the immediate area. The No 2 engine, BPCU and Generator Control Unit (GCU) were replaced. The fan cowl was permitted to continue in service in accordance with a Rolls-Royce Technical Variance. A number of electrical checks were carried out and the right hand IDG disconnect switch was found to malfunction intermittently during testing, preventing the switch from disconnecting the IDG. The IDG disconnect switch lights were also intermittent in operation. In addition, the No 1 engine IDG disconnect switch was found to be 'stiff'. The control panel on which both of these switches were installed was therefore replaced and this action successfully rectified the defects. This switch panel had been on the aircraft since it was delivered new in 1991, and the switches were of an earlier modification standard than current switches. There was no means available to the flight crew to determine if operation of the IDG disconnect switch had, in fact, disconnected the IDG successfully. Ground engineers also had no visual or other positive means of confirming disconnection of a failed IDG.

IDG failure

The IDG had been fitted to the aircraft on 10 March 1998 when the No 2 engine was installed. It was an 'on-condition' unit and had last been certified on 25 June 1996, since when it had operated for 4,108 hours. It was returned to the manufacturer for strip inspection. The associated strip report indicated that the IDG failure had been initiated by a worn or failed generator rotor roller bearing. The cause of the bearing failure was not determined, however if the disconnect system had operated correctly the gross damage would not have occurred. In the absence of IDG disconnection, due to the faulty disconnect switch, the generator rotor had eventually impacted the stator and both had been destroyed, rupturing the casing and releasing the oil and a small amount of debris. Although the failure was uncontained, nothing of significant mass or velocity was released. No evidence of fire damage to the IDG was reported by the manufacturer, but the operator considered that a limited fire had occurred, with the resultant damage to the fan cowl.

The Generator Control Unit 'memory' facility was interrogated by the IDG manufacturer, however due to memory capacity limitations no useful data was obtained. Both the GCU and the BPCU were found serviceable.

Operator safety action

As a result of this incident the operator has amended the Boeing 757 Aircraft Maintenance Schedule to require routine checking of the IDG disconnect function on 'S' checks, and a modification (EOC-757-024G150) has been introduced to retrospectively replace the early standard of Korry Swichlights as fitted to this aircraft with the later, more reliable, 'D' standard. Similar switches are also used in the passenger oxygen system, and it is understood that this corrective action will be taken on all such switches in safety-related applications across the operator's Boeing 757 and 767 fleets. This modification action is scheduled for completion by 30 September 1999.

Previous related Boeing Service Letters to operators

Boeing Service Letters 757-SL-24-049-A (applicable to Boeing 757 models), 737-SL-24-102-A (applicable to Boeing 737 models), 747-SL-39-015-A (applicable to Boeing 747 models) and 767-SL-39-018-A (applicable to Boeing 767 models), which had previously been issued on 15 February 1995, included the following 'Suggested Operator Action':

'Operators are encouraged to participate in the switch return program outlined in the Reference a) Korry service bulletin. Boeing recommends prompt retrofit of momentary non-lockout and momentary lockout master module assemblies (MMA) located in the following 747-400, 757, and 767 positions:

Master warning/caution switch P/N S231T290-1042/-4042, momentary non-lockout MMA

IDG disconnect switch P/N-1007/-4007, momentary lockout MMA

Passenger oxygen switch P/N-1041/-4041, momentary lockout MMA

Alternate gear extend switch P/N-1076/-4076 (757only), momentary lockout MMA

The P/N S231T290-1060/-4060 cargo fire bottle discharge switches also contain the lockout master module assembly and have been removed by Boeing from current production airplanes. The Reference 1), m), and n) Boeing service bulletins replace the switch P/Ns -1060/-4060 with the new P/N S231T290-4006 momentary action switch which does not have the lockout feature. Operators who have not incorporated the References 1), m), and n) service bulletins on applicable airplanes are encouraged to do so at this time.'

In addition, Boeing Service Letters 757-SL-24-037-B (applicable to Boeing 757 models), 747-SL-24-034-B (applicable to Boeing 747 models) and 767-SL-24-028-B (applicable to Boeing 767 models) had been previously issued on 21 September 1994. These Service Letters advised operators of Boeing fitment of modified IDGs to the above aircraft models during production and encouraged operators of aircraft with the previous standard of IDG to retrofit modified IDGs by requesting that the applicable Sundstrand Service Bulletins should be incorporated on their IDGs when these units were returned for overhaul. The associated IDG modifications included the fitment of a case vent system, to increase the oil and filter life, and the fitment of a thermal decoupler to provide additional protection to the IDG for over-temperature conditions. The Service Letter stated the following in relation to the thermal decoupler:

'The thermal decoupler was developed to prevent extensive internal damage to the IDG, which could occur in the event of a delayed manual disconnect or when a manual disconnect cannot be performed due to higher priority activities in the flight deck, or an open disconnect circuit.'

AAIB response

It was evident that Boeing and the associated component manufacturers had recognised these problems concerning IDG failures and related, and other, problems with the Korry Switchlights and had taken action to encourage operators to replace the previous standard of IDGs and switchlights by complying with the above Boeing Service Letters. In view of the availability to operators of the improved type D Korry Switchlights and the IDG modifications described above, and Boeing's recommendation for prompt retrofit of these switchlights [' Operators...are encouraged to do so at this time' (Service Letter dated 15 February 1995)] and encouragement of operators to embody the IDG modifications (Service Letter dated 21 September 1994), no related Safety Recommendations are made as a result of this investigation.